

Water Quality in Racine County Lakes

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This report describing water quality in Racine County lakes is for the use of home buyers and realtors who may be interested in properties on or near the lakefront. The focus is to compare the relative water quality of different lakes within the county using information gathered during lake monitoring conducted in 2000 – 2004.

Several measures of water quality are taken seasonally on Racine County lakes. Information was gathered and combined from three main sources for this report: 1) baseline monitoring by the Department of Natural Resources biologists, 2) USGS Monitoring and 3) Self-help Lake Monitoring by volunteers. The latter group consists of members of the general public living on or near area lakes. They make significant contributions to natural resource monitoring and conservation and their efforts are essential for maintaining water quality on lakes in the county.

Secchi disk depth and concentrations of phosphorous and chlorophyll are water quality variables consistently measured in lake monitoring. Secchi depth (i.e., the greatest depth at which a black and white painted disk lowered into the water remains visible) describes water clarity. Greater secchi depths (≥ 10 ft.) indicate relatively good water clarity. Total phosphorous values tell us about the nutrients available in the water for use in primary production (photosynthesis by algae and aquatic plants). Chlorophyll *a* concentrations are a measure of algal growth in a lake.

Values for each of these variables may change between seasons. Typical ranges and their corresponding Trophic State Index (TSI) values indicating overall water quality are listed in Table 1. The TSI uses water quality variables to describe the relative water quality of a lake. Index values range from 0 to 100; < 40 indicates **oligotrophic** conditions (low nutrients, clear water, generally free of algae blooms and abundant aquatic plant growth, and are capable of supporting a fishery of large game fish), 40-50 indicates **mesotrophic** conditions (increased nutrient levels and productivity, favorable water clarity with abundant plant growth and an increase in fish abundance and diversity, occasional algal blooms and subsequent oxygen depletion), and > 50 indicates **eutrophic** conditions (nutrient rich, highly productive water with the potential for intense algal blooms and nuisance aquatic plant growth). Eutrophic lakes can support large fish populations, but are susceptible to oxygen depletion. Figure 1 provides a general illustration of the different trophic states for lakes.

The pH of a lake also is commonly measured in water quality sampling. The pH values generally within the range of 7.0-8.2 considered to be healthy for most aquatic plants and animals. Values > 8.2 are indicative of hard water, often resulting from biological productivity and the release of CO₂. Water bodies with pH levels >8.2 are referred to as marl lakes.

Figure 1. Trophic states of lakes depicting the natural aging process



Table 1. Trophic classification of Wisconsin lakes based on the measures of water clarity, total phosphorous, and chlorophyll *a* (adopted from Lillie and Mason, 1993).

Trophic level	TSI	Secchi Depth (ft)	Total Phosphorous ($\mu\text{g} \cdot \text{l}^{-1}$)	Chlorophyll <i>a</i> ($\mu\text{g} \cdot \text{l}^{-1}$)
Oligotrophic	0	>12	<3	<2
	40	8	10	5
Mesotrophic	41	6	18	8
	50	6	27	10
Eutrophic	51	5	30	11
	100	<4	>50	>15

Eight Racine County lakes were sampled during the spring, summer, and fall of 2000 through 2004. Summary results and TSI values for each lake are found in Tables 2 and 3.

Table 2: *Summary statistics for water quality measurements in Racine County lakes, 2000-2004.*

Lake	average secchi (ft)	secchi range (ft)	average pH	pH range	avg. total phosphorous ($\mu\text{g} \cdot \text{l}^{-1}$)	avg. total phosphorous range ($\mu\text{g} \cdot \text{l}^{-1}$)	avg. chlorophyll a ($\mu\text{g} \cdot \text{l}^{-1}$)	Chlorophyll a range ($\mu\text{g} \cdot \text{l}^{-1}$)
Bohners	7.8	4.59-11.0	8.3	7.94-8.61	24.3	9-38	7.1	1-13
Brown	8.6	2.95-14.44	8.5	7.82-9.6	22	11-49	6.4	1.2-18.3
Buena*	1	0.98	8.8	8.82	167	167	46	46
Denoon*	9	9	8.6	8.6	15	15	4.6	4.6
Eagle	4	3.77-4.27	8.5	8.33-8.6	28	10-46	29	29
Tichigan	4.8	2.5-8.0	7.9	7.2-8.82	119.6	29-842	31.9	6-149
Waubeesee	9.3	7-12.8	8.9	8.9	13.3	12-16	3.2	3-3.3
Wind	4.6	2.3-7.55	7.7	7-8.5	63	9-237	13.6	5.11-42

* Only one set of samples was taken from 2000-2004.

Table 3: *Trophic State Index values for Racine County Lakes, 2000-2004.*

Lake	TSI average secchi	TSI average total phosphorous	TSI Average Chlorophyll <i>a</i>	Overall TSI	Trophic Status
Bohners	31	53	48	44	Mesotrophic
Brown	30	52	47	43	Mesotrophic
Buena	60	68	63	64	Eutrophic
Denoon	28	49	46	41	Oligo/Mesotrophic
Eagle	40	52	60	51	Meso/Eutrophic
Tichigan	38	61	58	52	Eutrophic
Waubeesee	28	48	43	40	Oligo/Mesotrophic
Wind	40	57	53	50	Meso/Eutrophic

Water quality was quite variable in the Racine County lakes sampled during the past four years. Denoon and Waubeesee Lakes both demonstrated good water quality (mesotrophic, borderline oligotrophic). Both lakes had secchi disk depth averages greater than 9 ft., an indicator of good water clarity. Denoon and Waubeesee Lakes also exhibited lower total phosphorous averages ($15 \mu\text{g}\cdot\text{l}^{-1}$ and $13.3 \mu\text{g}\cdot\text{l}^{-1}$) resulting in low to medium productivity. The total phosphorous levels for Denoon and Waubeesee lakes are below average for natural lakes ($25 \mu\text{g}\cdot\text{l}^{-1}$). The chlorophyll *a* averages for both lakes were also low ($4.6 \mu\text{g}\cdot\text{l}^{-1}$ and $3.2 \mu\text{g}\cdot\text{l}^{-1}$) which indicates lower algae productivity.

Bohner and Browns lakes demonstrated mesotrophic (moderate) water quality from 2000-2004. Bohner and Browns lake secchi disk averages were 7.8 ft. and 8.6 ft. respectfully, indicating moderate to good water clarity. Both lakes exhibited higher total phosphorous levels ($24.3 \mu\text{g}\cdot\text{l}^{-1}$ and $22 \mu\text{g}\cdot\text{l}^{-1}$). This indicates moderate to higher levels of productivity for both plants and algae. Bohner and Browns lakes average total phosphorus levels are both slightly above the average total phosphorus level ($25 \mu\text{g}\cdot\text{l}^{-1}$) for natural lakes. The chlorophyll *a* levels on these lakes were also moderate ($7.1 \mu\text{g}\cdot\text{l}^{-1}$ and $6.4 \mu\text{g}\cdot\text{l}^{-1}$) which can result in occasional algal blooms.

Eagle and Wind Lakes demonstrated moderate to poor water quality in the sampling seasons of 2000-2004 (mesotrophic/eutrophic). The average secchi disk depths for these two lakes were 4.0 ft and 4.6 ft respectfully. This indicates that the water quality was moderate to poor. The average total phosphorous level for Eagle Lake was $28 \mu\text{g}\cdot\text{l}^{-1}$. The average total phosphorous level for Wind Lake was $63 \mu\text{g}\cdot\text{l}^{-1}$, which indicates poor water quality. Eagle and Wind lakes both exhibited higher than average total phosphorus levels. The average total phosphorus level for natural lakes is $25 \mu\text{g}\cdot\text{l}^{-1}$. The average

chlorophyll *a* levels of Eagle and Wind Lakes were $13.3 \mu\text{g}\cdot\text{l}^{-1}$ and $29 \mu\text{g}\cdot\text{l}^{-1}$ respectfully, which indicates that there is a higher probability of algae blooms occurring.

Buena and Tichigan Lakes were classified as eutrophic because of their low water clarity (1.0 ft. and 4.8 ft. secchi averages). Both lakes are part of the Fox River Chain. Buena Lake was created by the placement of the dam on the Fox River. The dam is located in the Village of Waterford, Racine County. Buena Lake would be a marsh in the absence of the dam. Tichigan Lake is a natural lake, but the surface area of the lake was increased by the construction of the dam.

Both lakes are very nutrient rich. The average total phosphorous levels for Buena and Tichigan lakes were $167 \mu\text{g}\cdot\text{l}^{-1}$ and $119.6 \mu\text{g}\cdot\text{l}^{-1}$ respectfully. These total phosphorous levels are extremely high. The average total phosphorus level for impoundments is $65 \mu\text{g}\cdot\text{l}^{-1}$. The chlorophyll *a* levels were also very high. The average chlorophyll *a* values were $46 \mu\text{g}\cdot\text{l}^{-1}$ and $31.9 \mu\text{g}\cdot\text{l}^{-1}$ respectfully. Both lakes are very susceptible to frequent algae blooms.

The high total phosphorous levels in these lakes can be caused by several factors. A major contributing source is phosphorous runoff from both pervious and impervious surfaces. Examples of pervious surfaces are lawns, flower-beds, vegetable gardens, mulched surfaces, wooded areas, and prairie gardens. Impervious surfaces include sidewalks, roofs, driveways, parking lots, and streets. All these types of surfaces contribute varying levels of phosphorous inputs to lakes from tree leaves, flowers and seeds, grass clippings, animal and pet wastes, fertilizer, bird droppings, soil, rainfall and airborne dust. Pervious surfaces allow water to soak in the ground during a rain storm.

Impervious surfaces cause water to run off the property and to drain elsewhere (such as to a curb and storm drain).

The eight lakes tested in Racine County demonstrated a wide range of water quality. Denoon and Waubeesee lakes exhibited the best water quality of the lakes tested. Buena and Tichigan lakes exhibited the worst water quality of the lakes tested.

Additional water quality data as well as information on lake ecology can be found on the DNR website at <http://www.dnr.state.wi.us/org/water/fhp/lakes/selfhelp/index.htm>.